Future of VTOL Aviation

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Outline of presentation

- 2025 & 2035 scenarios / needs
- Mono Tiltrotor (MTR) features
  - Cargo/Utility
  - Attack
- Mono Tiltrotor advantages & benefits
- BTC business model
- Timeline
- Next steps
- References

Future VTOL Scenarios

- 2025: Fielded and battle tested capability
  - Precise discrete autonomous cargo moves
    - 4x400lbs/200kts/750nm/20k ft
    - 4x1000lbs/220kts/850nm/20k ft
  - Deliver and retrograde w/o MHE
  - From land or seabased distribution node
- 2035: Fielded capability
  - Capacity-based cargo moves
    - 1x20tn/260kts/1000nm/20k ft
    - ...or larger w/new engine program

Joint Multi-Role (JMR) Needs

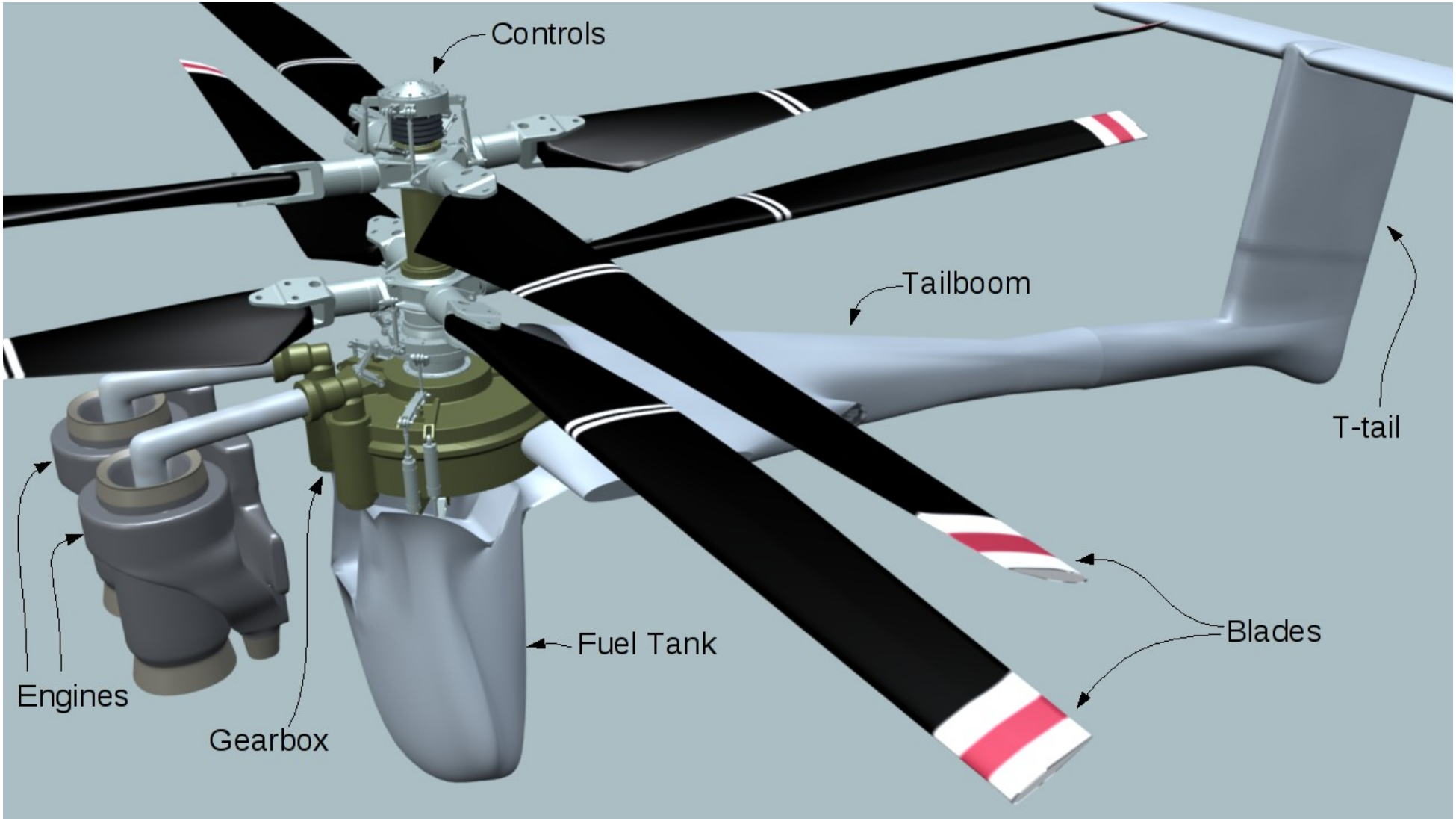
- Increased capabilities across the board
  - Expand all VTOL missions
- Lower costs
  - Robust, common air machine
  - Modular interface to mission packages
- Maintain/enhance industrial base
  - Advance subsystem technologies (off-ramp)
  - Vendor competition over full JMR life-cycle

MTR Cargo/Utility Features

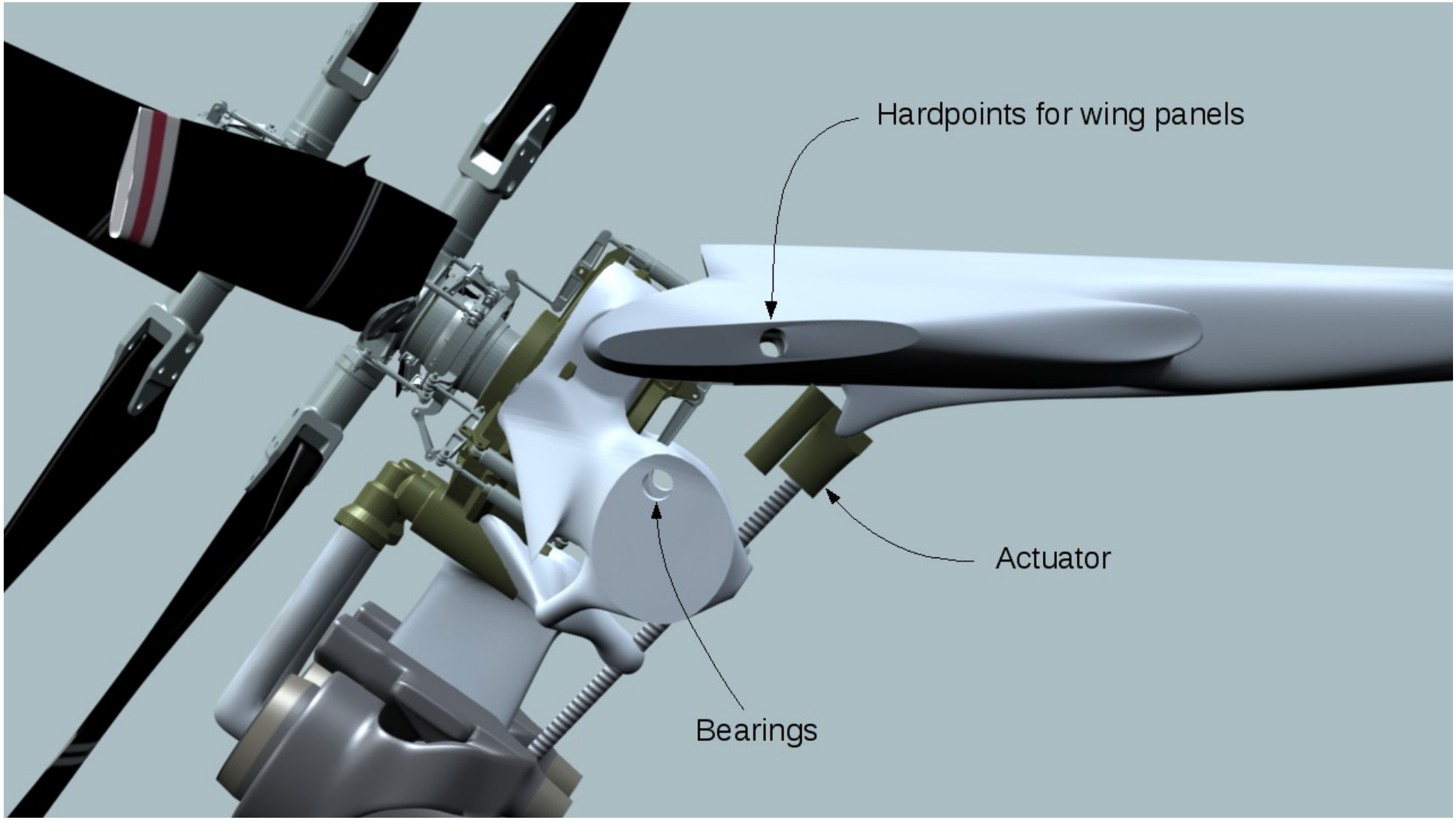
- Common drive system and tail assembly built from mature components & technologies
- Modular cargo pod
  - Joint Modular Intermodal Container
  - Pallet, cargo net, other...
- Modular, hinged, dry (no fuel) wing panels
  - Droop for maximum performance takeoff
  - Lock for cruise, for landing (, & for takeoff)

See videos and illustrations

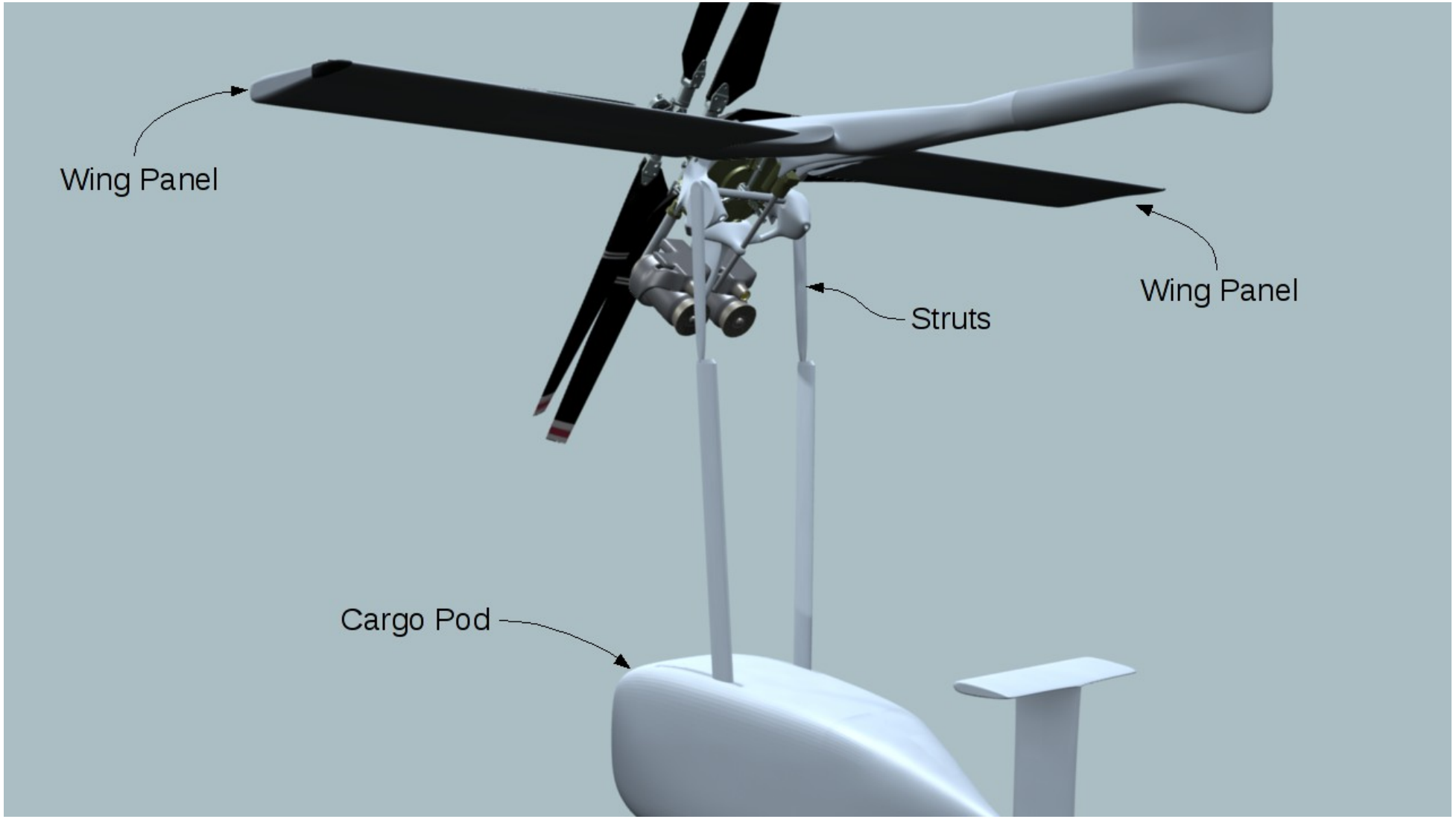
MTR Common Features



MTR Unique Features



MTR Cargo Features

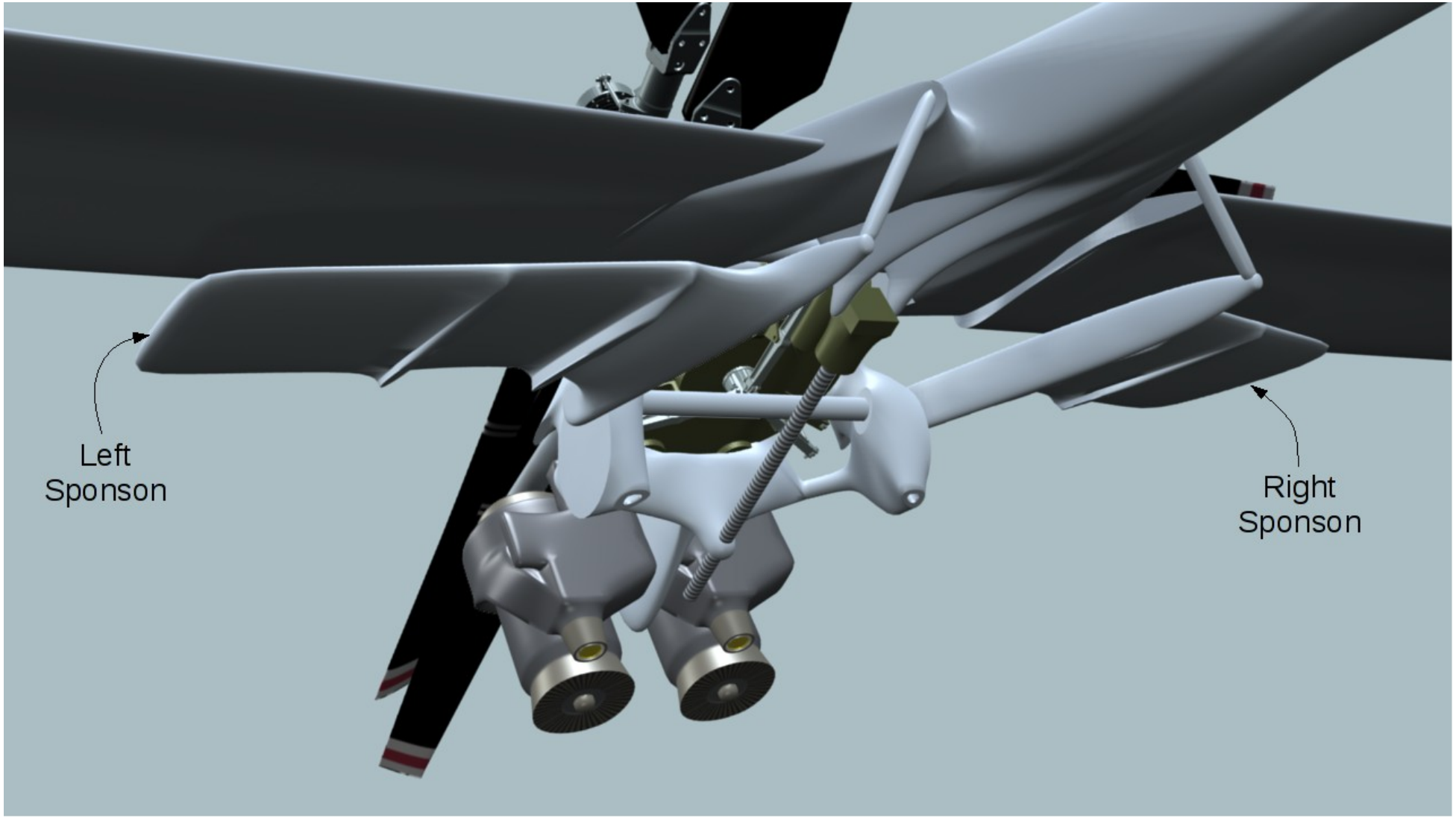


MTR Attack Features

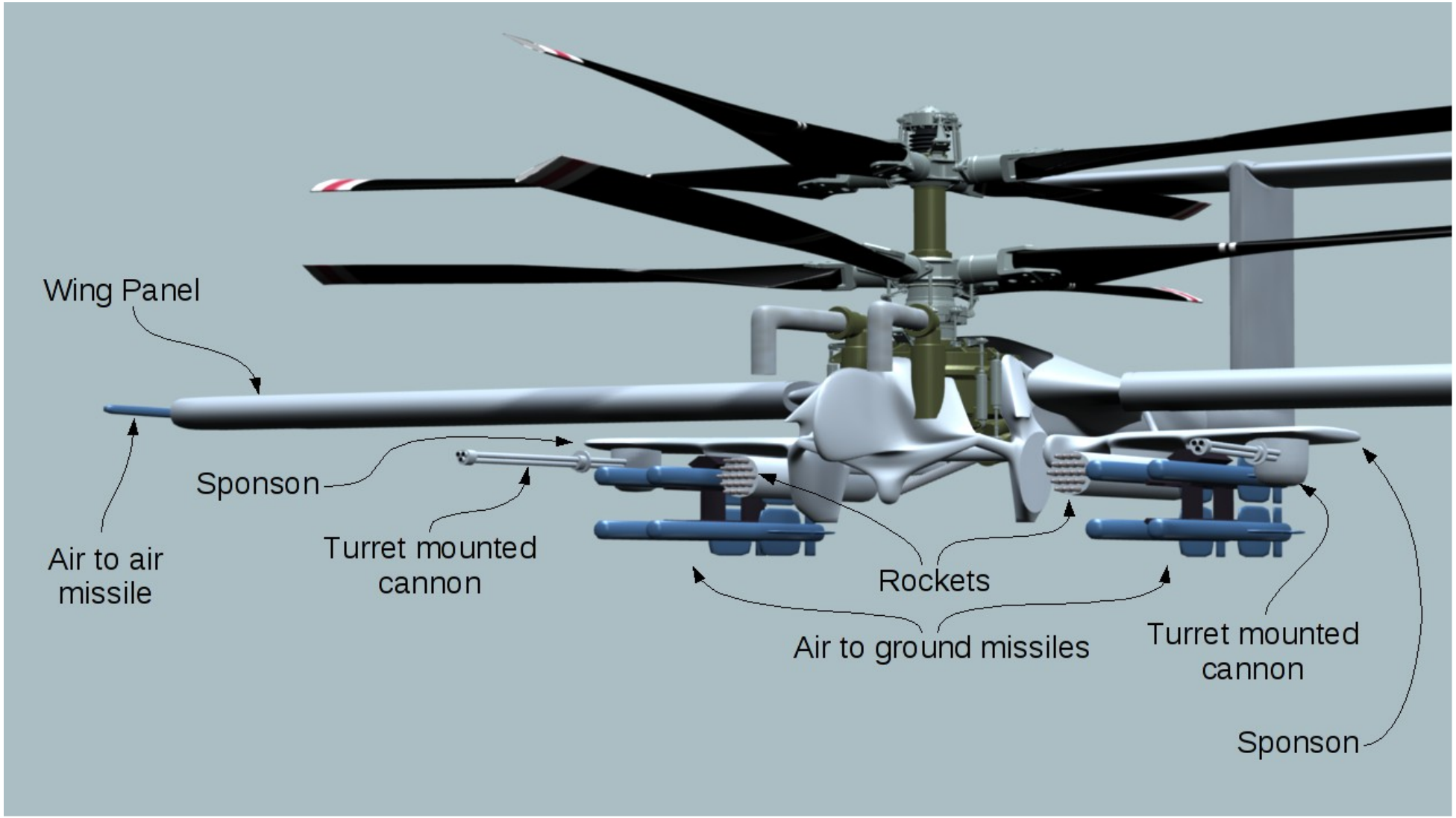
- Common drive system and tail assembly built from mature components & technologies
- Fixed, wet (fuel) wing with tip mounted AAM
- Eliminate cargo pod assembly
- Armaments supported by strut hardpoints
  - AGM
  - Cannons
  - Rockets

See videos and illustrations

MTR Attack Features



MTR Armaments



MTR Advantages

- In comparison to legacy helicopters for long range (750nm to 1000nm) cargo missions:
  - 1/3rd of the baseline structural weight
  - 1/3rd of the fuel burn
  - ½ of the size (i.e. rotor diameter)
  - Nearly twice the speed
- Performance advantage due to system level architecture [not due to subsystem advances]
  - Large disk with minimal download in hover
  - Optimal wing and small frontal area in cruise

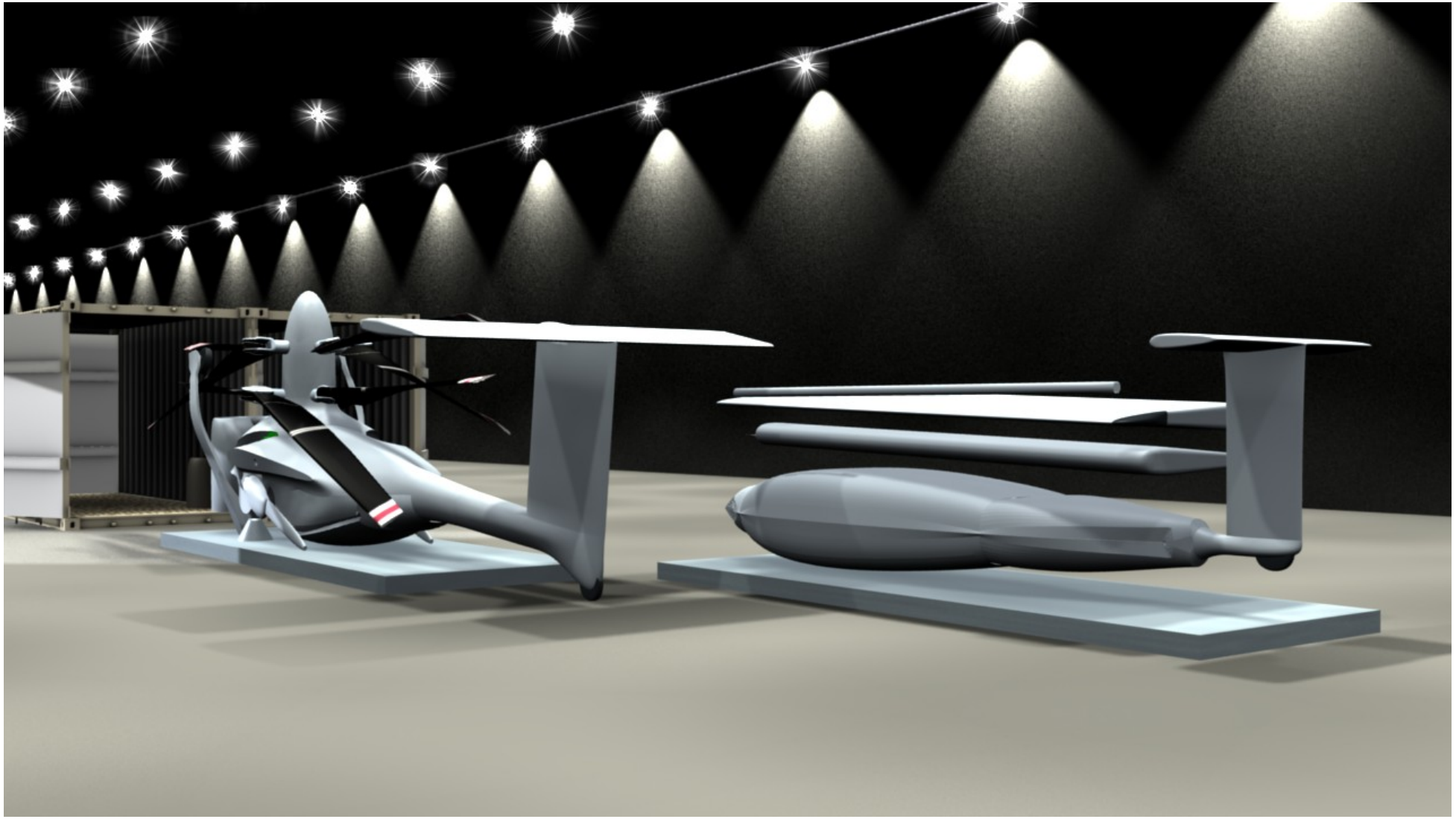
MTR Advantages (cont.)

- Common drive system and common hinged tail assembly for all missions and configurations...
  - Engines and gearbox
  - Hubs, blades, and controls
  - Tailboom, stabilizers, and control surfaces
  - Conversion actuator
- No reconfiguration of drive/tail assembly to re-missionize between cargo and attack roles

MTR Advantages (cont. 2)

- Mission packages are external to airframe
  - Relaxed cube constraints
  - Simple mechanical interface
  - Decouple from airframe program
- Modular airframe architecture
  - Disassembles for stowage and transport
  - Highly accessible components and sub-assemblies for maintenance actions

MTR Disassembly



MTR Benefits

- Breakthrough range/speed/payload using COTS components and technologies
- Reduced acquisition costs (weight of airframe)
- Reduced O&S costs (weight of fuel; modular)
- Reduced component S&T costs (COTS)
- Rapid reconfiguration between roles
  - Connect cables for cargo
  - Mount armaments for attack

BTC Business Model

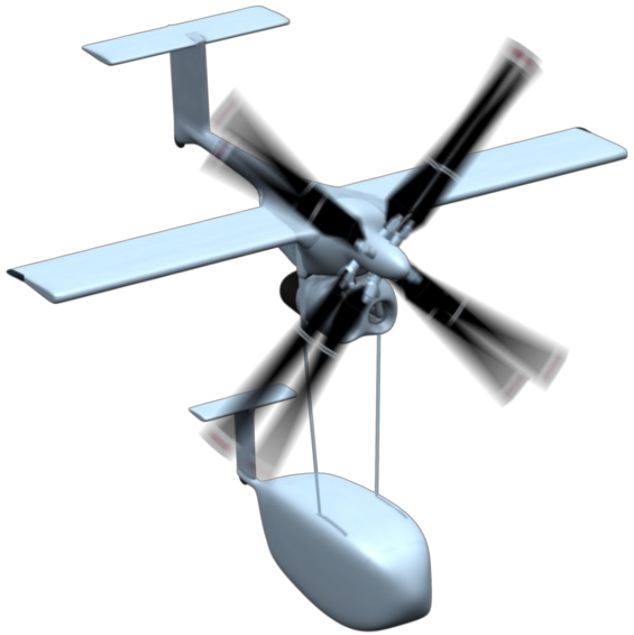
- Licensee of MTR patents for MTR research
- Funded by US Government R&D contracts
  - All deliverable data licensed to US Gov't
  - Preference to publish all reports
- Ad hoc, world-class R&D teams for each SOW
- Primary focus is on MTR technical bona fides
- Responsive to Government needs while advancing the understanding of the MTR
- Positioned for future teaming arrangement(s)

Extreme Development speeds time to market.

MTR R&D Timeline

- 2004: MTR Concept Study (ONR)
  - → Breakthrough performance possible
- '05/06: 3000lbs payload design (AATD)
  - → Point design created
- '07/08: Demonstration and Validation (AATD)
  - → Function demonstrated on RC flight models
  - → Point design independently validated
- '09/10: Cargo UAS Operations Study (ONR)
  - – Contract awards to Bell Helicopter & to BTC

Mono Tiltrotor (MTR)



Technology [TRL 4]

- Pitch axis suspended load air vehicle
- Efficient hover and cruise connector
- Sustain battlefield from sea or ashore

Design

- 3000lbs load, 750nm, 200kts, UAS
- 2xT800, 52% struct. eff., Cruise L/D=10
- 25ft rotor, 30ft span
- Sized for MILVAN transportability
- Sized to transport JMIC
- Reconfigures into an attack aircraft

Participants

- Army AATD – Ft Eustis; ONR
- Baldwin Technology Company (BTC) w/
  - Bell, GT, UMd, ARL, Eagle Aviation

Status and Plans

- ONR Conceptual Design Study – FY04
- AATD Concept/Prelim Design – FY05-06
- AATD Validation Activities – FY07-08
- ONR Operations Study - FY09-10

Research Contracts

Amounts ($K)	FY04	FY05	FY06	FY09	Total
ONR	277			690	967
AATD		810	819		1629

Benefits

- Breakthrough in vertical sustainment speed, range, and payload using COTS components and technologies
- 1/3 of structural weight & fuel compared to conventional helicopter at same range

MTR Next Steps

- For the first time in its development lifecycle, the MTR is becoming resource constrained
  - Very little funding was needed to answer basic questions regarding merit and value
  - MTR fundamentals are now understood, and commitment is needed to show operational potential to user community
- Will need Government support for TRL-5 demonstrations of suspended cargo pod and aerodynamic wing deployment using a medium lift UAS helicopter as a flying testbed

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